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the three photographs of November 1, taken at short intervals. The doubling of the line takes place so quickly that it is difficult to say when it is absolutely single, and hence the minima recorded in the table are only approximate.

It seems fair to assume that 370 miles per second is about the maximum relative orbital velocity, and this gives a little over five millions of miles as the distance between the components. The total mass will therefore be about 22½ times that of the Sun, and as there is no appreciable difference in the intensity of the K lines, or of the hydrogen lines as far as can be estimated from their partial separation, the masses of the components are probably about equal. These values will, of course, require modification if the plane of the orbit does not pass through the Sun. They must not yet be regarded as final, in consequence of the absence of a series of photographs taken at short intervals. Such a series will be obtained as soon as possible; they were not taken in the first instance because it was not suspected that the period was so short. Unfavourable weather has since prevented this being done, and I have taken this opportunity of bringing my results before the Society in the hope that some other observer with better atmospheric conditions may be induced to take up the question.

The mean value of the parallax of *α Lyræ*, as determined by the Struves, Peters, and others is $0''\cdot16$, and if we take this as correct, the angular distance between the components at the elongations would be $0''\cdot008$. If Elkin's value ($0''\cdot034 \pm 0\cdot045$) be taken, the angle will be very much less, and it is not likely, therefore, that the components will ever be separated by a telescope.

The instrument employed in the investigation was the 10-inch refractor belonging to the Royal College of Science, with two prisms of 7½° each in front of the object-glass. The length of the spectrum from F to K is about an inch and a half, and the maximum separation of the K lines in *α Lyræ* $\frac{1}{50}$th of an inch, or $35''$. The exposure was generally a quarter of an hour.

I have to express my obligation to Messrs. Rogers and Baxandall for assistance in taking the photographs.

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On the Variation of the Spectra of R Coronæ and R Scuti, and on the Spectra of R Aurigæ and R Andromedæ. By the Rev. T. E. Espin, B.A.

R Coronæ.—The observations of this star show a curious change of spectrum. Throughout the observations the star was examined on each night with different spectroscopes, and, beginning with feeble dispersion, the examination was continued till the highest dispersion the star would bear was reached.

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The spectroscope was very carefully focussed on the strong F line in *α Coronæ*. I give the results of the observations in detail:—

1890, *March* 26.—Very clear; moonlight. Star about 5·8 mag. Colour, yellowish white. Nothing certain seen; sometimes irregularities, either dark or bright lines suspected.

1890, *April* 10.—Continuous spectrum, but again suspected lines, one bright one strongly suspected near the place of F, but believed more refrangible.

1890, *September* 8.—A most wonderful change has taken place in this star's spectrum. Two large absorption bands have appeared, one in the bluish-green, and one in the bluish-violet. These bands are sharply defined on the least refrangible side. Bringing the spectrum to a line, bright patches were seen far away in the violet—these may be bright lines or bright spaces. The star is now pale yellow. The magnitude still about 6.

1890, *September* 14.—The spectrum is apparently of the IV. type, since the bands fade away on the more refrangible side, but are sharply defined on the less refrangible. The band in the bluish-green was thought to be occasionally resolved into fine lines; between the two bands a bright line was suspected. The star is of the same magnitude and now pale orange.

1890, *October* 8.—Heavy mist, eventually putting a stop to telescopic work. The star is only dim, but the bands seem to have faded.

1890, *October* 10.—The star has now nearly returned to the continuous first type spectrum observed in the spring. The big band in the bluish-green has disappeared, but the band in the violet is probably there still, but faint. The bright line previously mentioned again suspected. The star is now yellowish-white, and the magnitude about the same.

R Scuti: 1890, *August* 21. *III. Type.*—The bands are faint. Bands 1, 2, 3, of Dunér's nomenclature, seen, and also 7 and 8, which are the strongest.

1890, *August* 23.—Estimated 7·2; pale orange-red; carefully examined. The spectroscope each time focussed on λ *Aquilæ*. Type III., but peculiar. The usual bands, 1, 2, 3, seen, the bands 4 and 5 faint, 7 and 8 are strong. Bringing the spectrum to a line, bright knots seen in the violet and ultra-violet, either lines or spaces.

1890, *September* 8.—The bands 4 and 5 are much better seen to-night, but the other bands remain the same. The star is now brighter.

1890, *October* 10.—The star is now about 6 mag. The III. type spectrum is no longer certainly seen. A remnant of band 7 still remains; the others have almost, if not quite, disappeared. Perhaps 8 is there.

1890, *October* 12.—The star about 6 mag. Star low, tremulous, and type doubtful. Possibly III., but very indistinct.

1890, *October* 15.—The star is about 6·5. The spectrum is again clearly III. type. Bands 7 and 8 best seen, also 1 to 4

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visible. The bands are, however, faint and dim, but are larger now, and the spectrum is similar to that observed on August 21.

1890, *November* 1.—Normal III. type, and about 6·8 mag. The bands are well seen in all parts of the spectrum. Bands 7 and 8 are especially broad.

R Aurigæ: 1890, *August* 18.—Mag. 7·2; colour fine rose-red. Very fine III. type, and the spectrum appears to resemble that of *Mira* rather than *R Andromedæ*.

R Andromedæ: 1890, *August* 23.—Magnitude 7·3 ±. Bands not deep, except in the blue and violet. Bringing the spectrum to a line, several bright lines in the violet and ultra-violet suspected. F possibly bright, but not sure about this.

1890, *September* 8.—The star has increased in light, and γ *Hydrogen* and F certainly seen, but still faint.

1890, *September* 14.—Bands in the red well seen, the yellow bands faint. F very plain now.

1890, *September* 15.—The F line now a wonderful spectacle. The star is not so red, the bands are generally faint except in the red. A bright space in the yellow looks like a mass of fine bright lines. A deep band in the violet. Hγ and D_3 possibly bright.

Comparative Photographs of the High Sun and Low Sun Visible Spectra, with Notes on the Method of Photographing the Red End of the Spectrum. By Frank McClean, M.A.

The accompanying photographs represent the High Sun and the Low Sun visible spectra from (H) to (A). The High Sun spectrum has been taken, as far as possible, when the Sun's altitude was over 45°, and the Low Sun spectrum when it was under 7½°. The depth of atmosphere traversed for the Low Sun spectrum was thus about five times that traversed for the High Sun spectrum. A few exceptions to this rule are indicated in the accompanying Table. The elastic force of aqueous vapour in the atmosphere when each photograph was taken is given in the same Table.

The photographs are in sections numbered from I. to XIII. From I. to XI. they correspond to the divisions of Ångström's chart. The scale is also about the same, but in the photographs it varies as the secant of the angle through which the grating is turned from its central position. There is a slight break in the scale between Sections IV. and V., owing to a different object-glass being employed for the violet portion of the spectrum.

The corresponding sections of the High Sun and Low Sun spectra are mounted in juxtaposition, so as to show by comparison the atmospheric groups of lines. These groups divide themselves, on inspection, into two classes. Firstly, those in which the bulk of the lines grow uniformly darker as the Sun